Water Potential

- **Water potential** is a measurement that combines the effects of solute concentration and pressure
  - Determines the direction of movement of water
- Water flows from regions of higher water potential to regions of lower water potential
  - As a cell gains water, its water potential increases until equilibrium is reached
  - Potential refers to water's capacity to perform work
- Water potential is abbreviated as Ψ (psi) and measured in a unit of pressure called the **megapascal (MPa)**
- $\Psi = 0$ MPa for pure water at sea level and at room temperature
- Both pressure and solute concentration affect water potential
- This is expressed by the water potential equation: $\Psi = \Psi_S + \Psi_P$
- The **solute potential** (Ψ_S) of a solution is directly proportional to its molarity
- Solute potential is also called osmotic potential
  - An increase in solutes has a negative effect on water potential
  - As solute concentration increases, Ψ_S becomes more negative
- **Pressure potential** (Ψ_P) is the physical pressure on a solution
  - Can be positive or negative relative to atmospheric pressure
  - The pressure potential of a solution open to the air is zero
- Remember, water moves from regions of higher water potential to regions of lower water potential!

Water potential (Ψ) = pressure potential (Ψ_P) + solute potential (Ψ_S)

Pressure potential (Ψ_P):	In a plant cell, pressure exerted by the rigid cell wall that limits further water uptake.
Solute potential (Ψ_S):	The effect of solute concentration. Pure water at atmospheric pressure has a solute potential of zero. As solute is added, the value for solute potential becomes more negative. This causes water potential to decrease also. In sum, as solute is added, the water potential of a solution drops, and water will tend to move into the solution.

Solute potential (Ψ_S) = –iCRT

i =	The number of particles the molecule will make in water; for NaCl this would be 2; for sucrose or glucose, this number is 1
C =	Molar concentration (from your experimental data)
R =	Pressure constant = 0.0831 liter bar/mole K
T =	Temperature in degrees Kelvin = 273 + °C of solution

Name ____

Water Potential Practice

1. Go to http://www.phschool.com/science/biology_place/labbench/
2. Click on Lab 1: Diffusion and Osmosis
3. Review Concepts 1-5 by reading the descriptions of each concept and then clicking "Next Concept" or "Closer Look." Where applicable, you can also click "Animate."
4. Pay careful attention to Concepts 6-8, as they focus on the concept of Water Potential. Attempt to answer the questions in the yellow boxes for these concepts and be sure to check your answers as you go.
5. When you get to "Design of the Experiment," click on "Analysis of Results" and record your answers to the sample problems below.
6. Finally, click "Self Quiz" to complete the lab quiz and record your answers on the following pages to receive credit for them.

Sample Problems

The molar concentration of a sugar solution in an open beaker has been determined to be 0.3M. Calculate the solute potential at 27 degrees. Round your answer to the nearest hundredth.

Show Your Work Here:

Your answer:

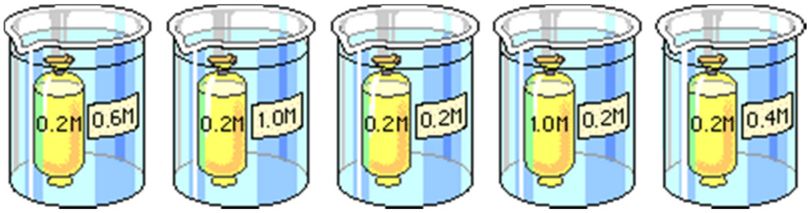
The pressure potential of a solution open to the air is zero. Since you know the solute potential of the solution, you can now calculate the water potential. What is the water potential for this example? Round your answer to the nearest hundredth.

Show Your Work Here:

Your answer:

Lab Quiz

1. Which beaker(s) contain(s) a solution that is hypertonic to the bag?



a. Beaker 3

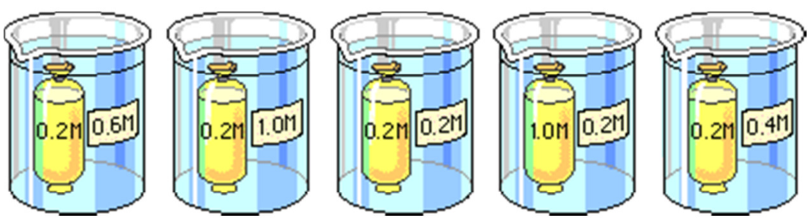
b. Beakers 2 and 4

c. Beakers 1, 2, and 5

d. Beaker 4

e. Beakers 3 and 4

2. Which bag would you predict to show the least change in mass at the end of the experiment?



a. The bag in Beaker 1

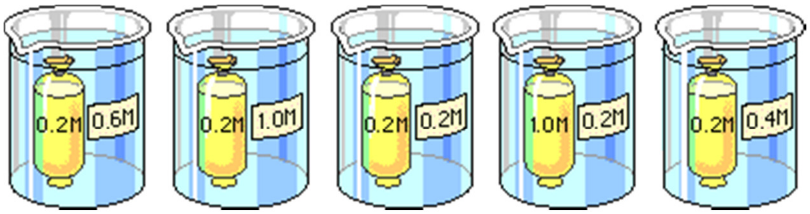
b. The bag in Beaker 2

c. The bag in Beaker 3

d. The bag in Beaker 4

e. The bag in Beaker 5

3. Arrange the beakers in order of the mass of the bags inside them after the experiment has run for 30 minutes. List the bag that loses the most mass first.



a. 1, 2, 3, 4, 5

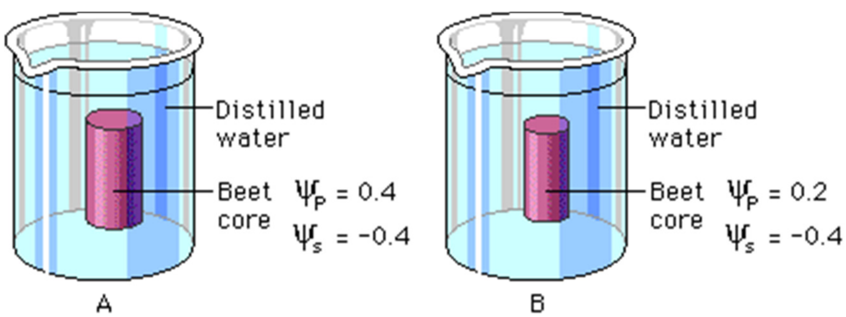
b. 1, 5, 2, 3, 4

c. 4, 3, 2, 5, 1

d. 3, 2, 1, 4, 5

e. 2, 1, 5, 3, 4

4. In beaker B, what is the water potential of the distilled water in the beaker, and of the beet core?



a. Water potential in the beaker = 0, water potential in the beet core = 0

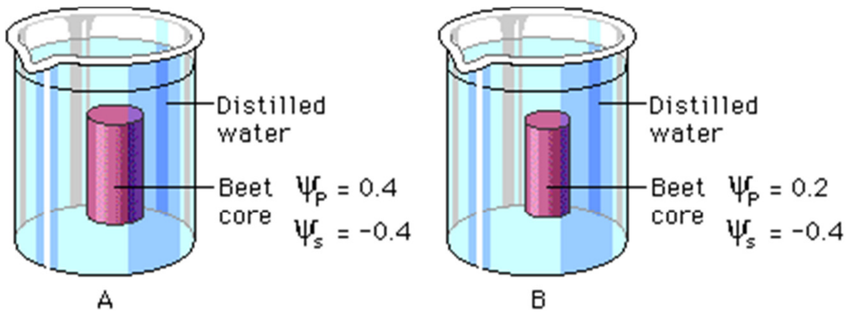
b. Water potential in the beaker = 0, water potential in the beet core = -0.2

c. Water potential in the beaker = 0, water potential in the beet core = 0.2

d. Water potential in the beaker cannot be calculated, water potential in the beet core = 0.2

e. Water potential in the beaker cannot be calculated, water potential in the beet core = -0.2

5. Which of the following statements is true for the diagrams?



- a. The beet core in beaker A is at equilibrium with the surrounding water.
- b. The beet core in beaker B will lose water to the surrounding environment.
- c. The beet core in beaker B would be more turgid than the beet core in beaker A.
- d. The beet core in beaker A is likely to gain so much water that its cells will rupture.
- e. The cells in beet core B are likely to undergo plasmolysis.